

# NAVAL HEALTH RESEARCH CENTER

---

## *GUIDELINES FOR DEVELOPING A PHYSICAL TRAINING PROGRAM FOR U.S. NAVY RECRUITS*

*S. A. Almeida  
K. Maxwell Williams  
R. Y. Minagawa  
D. M. Benas  
R. A. Shaffer*

19970811 063

DTIC QUALITY INSPECTED 2

*Technical Document 96-11K*

Approved for public release: distribution unlimited.



NAVAL HEALTH RESEARCH CENTER  
P. O. BOX 85122  
SAN DIEGO, CALIFORNIA 92186 - 5122

NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND  
BETHESDA, MARYLAND

Guidelines for Developing a Physical Training Program  
for U.S. Navy Recruits

Sandra A. Almeida, MD, MPH

Karen Maxwell Williams, MS

Rahn Y. Minagawa, PhD

Dana M. Benas, MPH

LCDR Richard A. Shaffer, MSC, USN (PhD, MPH)

Naval Health Research Center

P.O. Box 85122

San Diego, CA 92186-5122

Document No.96-11K supported by the Chief of Naval Education and Training, Department of the Navy, under work unit CNET REIMBURSABLE-6617. The views expressed in this paper are those of the authors and do not reflect the official policy of the Department of the Navy, the Department of Defense, or the U.S. Government. Approved for public release; distribution is unlimited.

## Table of Contents

Summary . . . . .	3
Chapter 1. Basic Principles of Physical Conditioning . . . . .	4
General Principles . . . . .	4
Cardiovascular Conditioning . . . . .	6
Muscle Conditioning . . . . .	8
Flexibility Training . . . . .	10
Warm-Up and Cool-Down . . . . .	11
Chapter 2. Application of Physical Conditioning Principles to Naval Training Center Great Lakes . . . . .	13
Naval Health Research Center Data (1995) . . . . .	13
Guidelines for the NTC Physical Training Program . . . . .	14
Chapter 3. Physical Training Modules . . . . .	16
Module 1: Aerobic Conditioning . . . . .	18
Module 2: Muscle Strength and Endurance Training . . . . .	20
Module 3: Low Intensity Training and Exercise (LITE) . . . . .	22
References . . . . .	23
Acknowledgments . . . . .	25
Appendix A . . . . .	A-1
Appendix B . . . . .	B-1

## **Summary**

### **Problem.**

Recruits at the Naval Training Center (NTC) Great Lakes are prone to training-related musculoskeletal injuries as a result of their relatively poor baseline fitness levels and the sudden increase in vigorous physical activity. Musculoskeletal injuries often result in lost training time, increased training costs, and decreased operational readiness.

### **Objective.**

The objective of this research was to evaluate the existing physical training schedule at NTC Great Lakes and to develop a balanced conditioning program that would reduce musculoskeletal injuries and promote sound, long-term fitness practices.

### **Approach.**

Phase 1 included data collection to determine injury rates, and baseline and post-training fitness levels of NTC recruits. Phase 2 focused on the quantification of existing physical activity patterns of basic training. The physical training schedule was reviewed, and it was determined that no standardized physical training protocol was in place. Recommendations were to develop a physical conditioning program based on principles of exercise science and the epidemiologic data collected during Phases 1 and 2.

### **Results.**

A physical conditioning program was developed targeting the needs of the U.S. Navy recruit population identified during study Phases 1 and 2. The program included cardiovascular endurance, muscular strength and endurance, and flexibility. All exercise techniques were modifiable for land-based and shipboard environments and required no special equipment.

### **Conclusion.**

We concluded that a simple, cost-effective, physical conditioning program based on scientific principles and epidemiologic data will maximize fitness gains and minimize exercise-related injuries in NTC recruits. Fitness programs that can be continued throughout a sailor's career can be taught during boot camp.

## Chapter 1. Basic Principles of Physical Conditioning

### General Principles

\* *Total Body Fitness:* Physical fitness refers to an individual's ability to efficiently perform both aerobic and strength-related activities and to that individual's ability to maintain such capacity throughout life. A physically fit person has cardiovascular endurance, anaerobic capacity, muscular strength and endurance, high lean body mass relative to body fat, and joint flexibility for optimal range of motion.

\* *Balanced Training:* A balanced physical fitness program includes four major training elements: (a) aerobic (cardiovascular), (b) muscle strength and endurance, (c) flexibility, and (d) warm-up/cool-down. More advanced forms of conditioning not recommended for beginners due to the high injury potential include: (a) anaerobic training (30- to 90-second bouts of high intensity exercise), (b) speed work (10- to 30-second sprints), and (c) power exercises (bursts of high intensity muscle force).

\* *Gradual Overload:* A conditioning program must gradually and progressively overload the cardiovascular and musculoskeletal systems to produce fitness gains. As a general rule, weekly training loads should not be increased more than 10% to 15%.

\* *Specificity:* The training response is specific to the type of exercise used. For example, strength training produces predominantly

strength gains with little effect on cardiovascular endurance. Likewise, the best way to improve running performance is to incorporate running into the training program. Therefore, training programs should include the four major elements of general physical conditioning along with sport- or mission-specific training.

\* *Detraining:* Exercise must be continued on a regular basis to maintain fitness gains. Significant reductions in cardiovascular fitness occur within only 2 weeks of cessation of physical training. However, the amount of exercise required to maintain fitness is lower than that needed to improve fitness.

\* *Injury Prevention:* Musculoskeletal injuries are the most common risks associated with routine exercise. Training variables and personal characteristics associated with increased injury rates include: (a) higher weekly training volume (total amount of training such as weekly running mileage), (b) abrupt increases in training volume or intensity, (c) improper exercise technique, (d) poor baseline fitness levels, (e) lack of prior exercise experience, and (f) prior musculoskeletal injury that has not fully recovered. General principles of injury prevention include: (a) *gradual* progression in training volume and intensity, particularly for the previously sedentary; (b) warm-up and cool-down sessions before and after all vigorous exercise; (c) proper exercise technique; (d) relative rest days after high intensity cardiovascular or resistance training to allow adequate time for tissue recovery and adaptation; and (e) proper management of injuries.

## Cardiovascular Conditioning

\* The first step in any conditioning program is to build an aerobic base. This step requires 2 to 4 sessions per week of continuous aerobic activity, such as jogging or brisk walking, for 15 to 30 minutes at a moderate intensity. For most recruits, moderate intensity exercise will produce a heart rate of approximately 130 to 150 beats per minute and a perceived exertion of "moderately hard." Faster is not better. As long as the recruit gets his/her heart rate into the target range, running a given distance will produce approximately the same aerobic training effect, and same caloric expenditure, whether it is run at a 10-minute-mile pace or a 6-minute-mile pace. In general, a minimum of 4 to 6 weeks is recommended for a healthy young adult to build an aerobic base.

\* For beginning runners, running frequency greater than 3 sessions per week, or duration longer than 30 minutes per workout, are associated with a significantly increased risk of musculoskeletal injuries. The gains in aerobic capacity with longer or more frequent running sessions are minimal relative to the increased injury risk.

\* To minimize injury risks, only one running variable should be increased with consecutive training sessions. Running variables include distance per session, intensity (pace), weekly frequency, and difficulty of terrain. As a general rule, distance and frequency should be increased before intensity. High intensity training, such as sprints, interval fartleks, and "Indian runs" should be reserved for those individuals who have already built a firm aerobic base and a

neuromuscular adaptation to running through several weeks of a regular jogging program.

\* Modified interval or training can be used to expand an individual's aerobic base and increase his/her capacity to run faster for longer periods of time. This training is performed by alternating 2- to 4-minute intervals of moderately low intensity running (40% to 60% of maximum effort, perceived exertion of "moderately easy") with 2- to 3-minute intervals of moderately high intensity running (70% to 80% of maximum effort, perceived exertion of "moderately hard") for 4 to 6 repetitions. This form of training will improve the recruits' average running speed in preparation for Physical Readiness Tests. To minimize injury risk, this type of training should be performed on nonconsecutive days and no more than 2 times per week.

\* Stride length varies among recruits. Formation runs are more likely to cause injury than individual runs by forcing alterations in natural stride length and reducing biomechanical efficiency.

\* Cardiovascular fitness gains are lost very rapidly after the cessation of routine aerobic exercise. Significant reductions in aerobic capacity occur within 2 weeks, with many individuals returning to near baseline in just a few months. Although the minimal level of exercise required to maintain cardiovascular fitness is not known, studies suggest that as little as 15 to 20 minutes of aerobic exercise, performed 2 times per week, may be adequate as long as training intensity remains constant.



## Muscle Conditioning

\* Muscle conditioning consists of both muscle strength and endurance training. For general fitness, it should occur 2 to 3 times per week on nonconsecutive days for specific muscle groups. An exercise is considered primarily strength training if it produces temporary fatigue in the targeted muscle group within 60 to 90 seconds (generally, 6 to 10 repetitions at relatively high resistance). For muscle endurance training, multiple repetitions (more than 20) are performed using lower resistance. A gradual progression in the resistance used, and in the number of repetitions and sets performed, will maximize both safety and training benefits. For novice weightlifters, it is safer to begin with lower weights and higher repetitions. To start, most experts recommend 1 to 3 sets of 8 to 12 repetitions to temporary muscle fatigue.

\* Studies have shown that 1 set of 8 to 12 repetitions, at a resistance high enough to produce temporary muscle fatigue, performed 2 days a week will stimulate significant strength gains in the muscle group exercised. Although higher frequencies of training and more sets will produce a greater training response, the additional strength gains are usually small. Note: A warm-up set of 15 to 20 repetitions at relatively low resistance should precede lifts involving large muscle groups (e.g., squats, bench press, leg press).

\* Calisthenics are exercises that use body weight to produce resistance. They can be used for both muscle strength and endurance training. For the poorly fit recruit who can only perform a minimal number of repetitions, the exercises are primarily a form of strength

training. For more fit recruits who can perform multiple repetitions, calisthenics are primarily a form of muscle *endurance* training.

\* Resistance training is specific to the body part trained and to the range of motion through which the muscles are exercised. Strength gains occur only in the exercised muscles through the range of motion performed plus or minus an additional 10 to 20 degrees. For example, if an individual performs knee extension exercises through a range of 60 to 90 degrees, his/her knee extensors will become stronger within a range of motion of approximately 40 to 110 degrees. Therefore, all major muscle groups generally should be exercised through a full, *normal* range of motion. There are a few exceptions to this rule, which are discussed in the following paragraph. Extremes of motion should be avoided due to the increased injury risk.

\* Exercise technique is important for both training effectiveness and injury prevention. All exercises should be performed in a *slow*, controlled manner. Some experts recommend at least 6 seconds per repetition. Proper body position will maximize training benefits and reduce injury risk. Low back pain and knee injuries are common exercise-related problems. Any exercises that result in (a) low back extension beyond 15 to 20 degrees or (b) full flexion at the waist with straight knees, place increased stress on the lower spine and should be avoided. Likewise, flexion of the knee beyond 90 degrees is not recommended since it significantly increases the forces generated behind the patella (kneecap).

\* "Super circuit training" combines muscle conditioning and cardiovascular exercises to produce both a strength and aerobic

\* "Super circuit training" combines muscle conditioning and cardiovascular exercises to produce both a strength and aerobic training stimulus. In a super circuit course, resistance exercises are alternated with 30- to 60-second bouts of moderate intensity aerobic exercise with minimal to no rest periods. The resistance exercises can be performed using free weights, weight machines, or calisthenics. Examples of moderate intensity aerobic exercise include brisk walking, high stepping, and jogging. For maximum training effectiveness and safety, the resistance exercises should be sequenced such that (a) large muscle groups are exercised first, and (b) consecutive exercises target different muscle groups. Since circuit training produces less aerobic fitness gains than continuous aerobic exercise, it should not be used as the only form of aerobic training.

\* Cessation of resistance training will result in a progressive loss of muscular strength over a few months' time. Studies suggest that strength can be maintained with only one weight lifting session per week as long as intensity is maintained.

### **Flexibility Training**

\* Flexibility refers to joint range of motion. Limited flexibility is the result of tight muscles, tendons, and/or joint capsules. The resulting reduction in normal joint range of motion is believed to contribute to reduced performance and increased injuries. The purpose of flexibility training is to produce a permanent stretch in the muscles and connective tissues to allow full joint range of motion.

\* Ideally, stretching exercises should occur before *and* after any strenuous physical training as follows:

WARM-UP --> stretch --> exercise session --> STRETCH

Since muscles are most flexible when they are warm, a 10- to 15-minute warm-up session should always precede any stretching exercises to minimize the risk of tearing tissues. Appropriate warm-up activities include brisk walking, slow jogging, and light calisthenics. The pre-exercise stretching should be activity-specific. For example, if the exercise session will include mostly running, the lower extremity muscles should be stretched. Flexibility training is most effective in producing longterm results when performed after the exercise session, when the muscles are the warmest.

\* Flexibility is very joint-specific. Therefore, postexercise stretching should target all major muscle groups. The recommended frequency is 3 to 5 times per week.

\* For maximum safety and effectiveness, stretches should be: (a) slow and static (no bouncing); (b) held for 10 to 20 seconds; (c) taken to the point of tightness, not pain; and (d) performed with proper biomechanical technique.

#### Warm-Up and Cool-Down

\* The warm-up allows a gradual redistribution of blood flow to the muscles, preparing both the cardiovascular and musculoskeletal systems

for the exercise session. The increased blood flow to the muscles produces a warming effect, increasing the elasticity of the muscles and connective tissues, which is believed to reduce injury risks. The warm-up should: (a) last a minimum of 10 to 15 minutes, (b) use large muscle groups, and (c) gradually progress to the target activity. For example, 10 to 15 minutes of brisk walking, gradually increasing in pace, would be an appropriate warm-up for a running workout.

\* The cool-down allows the body to gradually return to the resting state. The cool-down should: (a) last a minimum of 10 to 15 minutes; (b) use the same large muscle groups, in a similar activity pattern, as used in the preceding exercise session; (c) gradually decrease in intensity; and (d) finish with stretching exercises targeting all major muscle groups. An appropriate cool-down session for a running workout would be a slow jog, gradually decreasing in pace to a brisk walk, followed by a total body flexibility routine.

## Chapter 2. Application of Physical Conditioning Principles to Naval Training Center Great Lakes

### Naval Health Research Center Data (1995)

Studies conducted by Naval Health Research Center determined the following information:

1. *Baseline aerobic fitness levels of recruits* arriving at Naval Training Center (NTC) Great Lakes (based on initial Physical Readiness Test [PRT] 1.5-mile run times):

Males: average male = low to fair (average run time = 11:49 minutes)

> 30% = poor to very poor (run times > 12:11 minutes)

Females: average female = fair (average run time 15:39 minutes)

> 20% = poor to very poor (run times > 16:55 minutes)

2. *Aerobic fitness levels of graduating recruits* (based on final PRT 1.5-mile run times):

Males: average male = good to excellent (average run time = 9:57 minutes)

Females: average female = excellent (average run time = 12:16 minutes)

3. *Incidental movement distances* (recruit movement from training site to training site):

20 to 25 miles per week on average

4. *Musculoskeletal injury rates*:

Males: 13.9%

Females: 26.9%

#### **Guidelines for the NTC Physical Training Program**

\* Given the relatively poor baseline fitness level of the average recruit, the physical conditioning program should start with low to moderate intensity exercise and focus on building an aerobic and muscular strength and endurance base.

\* The incidental movement distances constitute a high training volume for the average recruit. If this movement is performed as brisk walking or marching for bouts of 10 or more continuous minutes, it will produce a significant aerobic training stimulus for most of the recruits.

\* The final PRT 1.5-mile run times showed significant improvements in aerobic capacity for both male and female trainees. This suggests that the movement miles, in conjunction with the aerobic physical training performed during boot camp, produced an adequate training stimulus.

\* Given the high movement mileage, 2 scheduled running sessions per week of 1.0 to 1.5 miles, at a moderate intensity pace, likely will provide adequate aerobic conditioning as well as preparation for the final PRT run. Additional high-impact aerobic exercise is not recommended due to the increased risk of overuse injuries to the lower extremities. All running should occur on nonconsecutive days to allow for tissue recovery and relative rest.

\* Weather and field house unavailability may restrict some training sessions to the barracks. The hard floors of the standard military barracks provide minimal shock absorption. High-impact activities, such as running in place and high-impact aerobics, should be modified to low-impact techniques to minimize the injury risk to the lower extremities.

\* In general, the recruits' physical training program should include: (a) 2 to 3 sessions per week of aerobic training on nonconsecutive days, (b) 2 to 3 sessions per week of a balanced muscle strength and endurance program on nonconsecutive days, (c) 4 to 5 sessions per week of a total body flexibility routine, and (d) warm-up and cool-down sessions before and after each exercise session, respectively.



### Chapter 3. Physical Training Modules

\* This chapter includes recommended training modules that can be used to build a physical training schedule for NTC recruits. Three different modules were developed: (a) Aerobic Conditioning, (b) Muscle Strength and Endurance Training, and (c) Low Intensity Training and Exercise (LITE). Each module consists of an entire workout routine, including warm-up and cool-down exercises, designed to be performed in one session. Illustrations and written descriptions of proper technique for the warm-up, calisthenic, and flexibility exercises are presented in Appendix A.

\* Each module contains exercise routines that are (a) time-efficient; (b) easy to perform without any special equipment; and (c) modifiable for indoor, outdoor, or shipboard environments.

\* General guidelines for placement of the modules throughout the 8-week NTC schedule include: (a) 2 to 3 sessions per week of aerobic training on nonconsecutive days, with a *maximum* of 2 sessions per week of *high impact* aerobic exercise (e.g., running); (b) 2 to 3 sessions per week of muscle strength and endurance training on nonconsecutive days; (c) LITE workouts during scheduled physical training blocks in the 1 to 2 days preceding PRTs; and (d) a maximum of 5 total scheduled exercise sessions, including aerobic, strength, and LITE workouts, per week.

\* The muscle strength and endurance component of the program utilizes calisthenics since they do not require any additional equipment. Although these exercises will provide an adequate total

body workout, the number of safe and effective calisthenics is limited. In addition, these exercises will provide primarily muscle endurance training, and little strength training, to the physically fit recruit who can perform multiple repetitions without fatigue. Training variety, enjoyment, and potential benefit could be enhanced with the addition of some relatively inexpensive equipment, such as dumbbells and resistance bands.

\* The modules were designed to physically condition the average NTC recruit (low to fair baseline fitness). The exercise routines can be modified depending on baseline fitness levels and performances of each new class of trainees. To challenge the more physically fit recruits, the runs can be performed in "ability groups," such that more fit individuals run at a faster pace. Likewise, the more fit recruits can perform more sets and repetitions of the calisthenics. Effort should be made to maintain the intensity levels as recommended for each recruit. Higher than recommended intensities likely will result in increased training-related injuries.

\* Appendix B provides a recommended 8-week physical training schedule for NTC recruits which utilizes the training module system. The schedule was designed to (a) maximize fitness gains during recruit training, (b) minimize training-related musculoskeletal injuries, and (c) promote longterm exercise practices among Navy recruits.

## **Module 1: Aerobic Conditioning**

### **1. Warm-Up (10 to 15 minutes) (see Appendix A)**

Jumping Jacks

Arm Circles

Brisk Walk

Knee Lifts

### **2. Aerobic Conditioning Routine (20 to 40 minutes)\***

*A. Outdoor or Field House* (maximum of 2 times per week):

1.0- to 1.5-Mile Run

*B. Barracks or Field House* (choose/combine any of the following):

1. High Stepping (low impact)

2. Brisk Walking

3. Super Circuit Course\*\*

4. Low Impact Aerobics

\* Intensity should be moderate (60% to 80% effort, perceived exertion of "moderately hard")

\*\* High stepping or brisk walking for 30 to 60 seconds, alternating with 30 to 60 seconds of calisthenics.

### **3. Cool-Down and Flexibility Training (10 to 15 minutes)**

The cool-down routine should use the same muscle groups in a

similar activity pattern as the preceding exercise session. The intensity should gradually decrease from that of the exercise session. For example, to cool-down from a running session, recruits could jog for a few minutes then brisk walk. Once the cardiovascular system has returned to a near-resting state (5 to 10 minutes), the cool-down should conclude with a total body stretching routine. All stretches should be performed in a static manner, without bouncing, and held for 10 to 20 seconds.

*Stretches* (see Appendix A):

1. Neck Stretch (neck)
2. Rounded Shoulder Reach (upper back, shoulders)
3. Chest, Shoulder, and Biceps Stretch
4. Back Scratch Stretch (triceps)
5. Overhead Side Bends (trunk)
6. Spinal Twist (lower back, iliotibial band)
7. Seated Butterfly Stretch (groin muscles)
8. Standing Hip Flexor Stretch (hip flexors, calf muscles)
9. Supine Hamstring Stretch (hamstrings)
10. Prone Quadriceps Stretch (quadriceps, shin muscles)
11. Straight & Bent-Knee Standing Calf Stretch (calf muscles)

## **Module 2: Muscle Strength and Endurance Training**

### **1. Warm-Up (10 to 15 minutes)**

Same as in Module 1.

### **2. Muscle Strength and Conditioning Routine (20 to 40 minutes)**

Group A exercises target all of the body's major muscle groups. They should be performed, in the order listed, during each scheduled strength and conditioning session. Group B exercises may be added for variety and to increase the training stimulus. The number of exercise sets and repetitions performed should gradually progress from Week 1 to Week 8. For example, Week 1: 2 sets of 20 to 30 repetitions of each exercise; Week 8: 2 to 3 sets of 30 to 50 repetitions of each exercise. Recruits should feel temporary muscle fatigue at the completion of each set. Rest periods between sets should be approximately 2 minutes.

Group A (see Appendix A):

1. Push-Ups (chest and shoulders)\*
2. Squats (hamstrings, quadriceps, gluteals)
3. Toe Raises (shin muscles)
4. Heel Raises (calf muscles)
5. Narrow Grip Push-Ups (chest, triceps)\*
6. Front Lying Chest Lifts (back)
7. Trunk Curls (abdominals)

*Group B* (see Appendix A):

1. Lunges (hamstrings, quadriceps, gluteals)
2. Outer Thigh Lifts (hip abductors)
3. Inner Thigh Lifts (hip adductors)
4. Front Lying Leg Lifts (gluteals)
5. Twisting Trunk Curls (abdominals, obliques)
6. Hip Rollers (abdominals)

\* If a recruit cannot maintain proper technique, he/she should perform modified push-ups (knees on the deck).

### **3. Cool-Down and Flexibility Training (10 to 15 minutes)**

Same as in Module 1.

### **Module 3: Low Intensity Training and Exercise (LITE)**

#### **1. Warm-Up (10 to 15 minutes)**

Same as in Module 1.

#### **2. Low Intensity Training and Exercise Routine**

A. *Outdoor or Field House* (30 to 40 minutes):

(1) 1.0- to 1.5-Mile Slow Jog

(2) Cool-Down and Flexibility Training (same as in Module 1)

B. *Barracks* (10 to 20 minutes):

Flexibility Training (same as in Module 1)

## References

American College of Sports Medicine. (1995). *ACSM's guidelines for exercise testing and prescription* (5th ed.). Baltimore: Williams & Wilkins.

American College of Sports Medicine. (1993). *Resource manual for guidelines for exercise testing and prescription* (2nd ed.). Baltimore: Lea & Febiger.

American College of Sports Medicine. (1990). The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness in healthy adults. *Med Sci Sports Exerc*, 22, 264-274.

Anderson, B. (1980). *Stretching*. Bolinas, CA: Shelter Publications.

Baechle, T. R. (Ed.). (1994). *National Strength and Conditioning Association: Essentials of strength training and conditioning*. Champaign, IL: Human Kinetics.

Cantu, R. C., & Micheli, L. J. (Eds.). (1991). *ACSM's guidelines for the team physician*. Philadelphia: Lea & Febiger.

Pollock, M. L., & Wilmore, J. H. (1990). *Exercise in health and disease: Evaluation and treatment for prevention and rehabilitation* (2nd ed.). Philadelphia: W.B. Saunders.



Sudy, M. (Ed.). (1991). *American Council on Exercise: Personal trainer manual*. Boston: Reebok University Press.

Weineck, J. (1990). *Functional anatomy in sports* (2nd ed.). St. Louis: Mosby Year Book.

Westcott, W. (1995). *Strength fitness: Physiologic principles and training techniques* (4th ed.). Madison, WI: Brown & Benchmark.

Wilmore, J., & Costill, D. (1994). *Physiology of Sport and Exercise*. Champaign, IL: Human Kinetics.

### **Acknowledgments**

The authors wish to thank Patty Tracey for her assistance in the coordination of this project and Elizabeth Badong, Barbara Bales, Denise Leone, and Dan Rahilly for their expertise in preparing this document. Their technical skills and insightful recommendations contributed significantly to the success of this manual. We also thank Naval Officer Candidate Gregg A. Williams for his participation as the exercise model.

## Appendix A

### Warm-Up, Calisthenic, and Flexibility Exercises

## WARM-UP



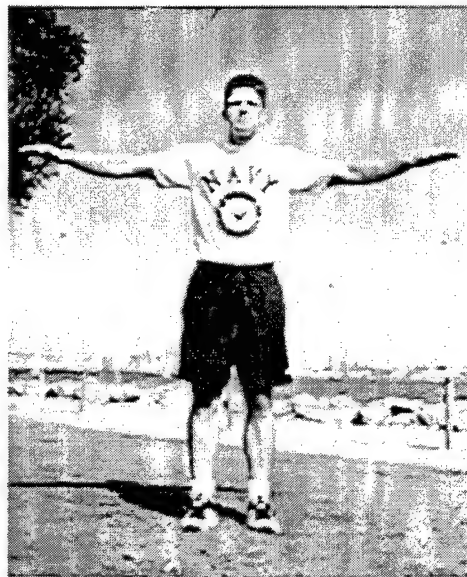
**FIGURE 1A. Jumping Jacks**

**STARTING POSTION:** Stand erect with feet together and hands placed at sides.

**ACTION:** Swing arms up and overhead, and spread feet apart in one movement. Return to starting position.



**FIGURE 1B. Jumping Jacks Cont.**



**FIGURE 2. Arm Circles**

**STARTING POSTION:** Stand erect with feet shoulder-width apart and arms extended to sides.

**ACTION:** Rotate arms forward in large circles. Repeat, rotating arms backward. Relax neck, and do not shrug shoulders.

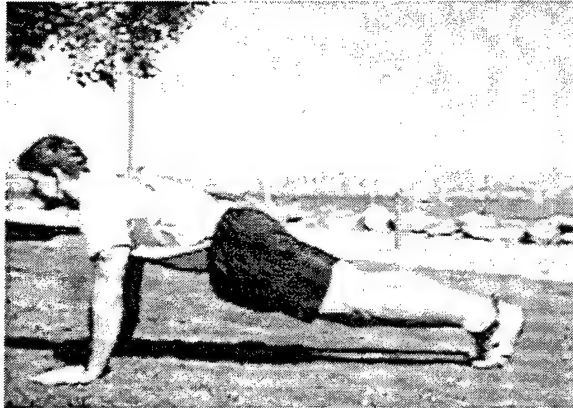


**FIGURE 3. Knee Lifts**

**STARTING POSTION:** Stand erect with feet shoulder-width apart and hands on waist.

**ACTION:** Slowly march in place, raising each knee to a 90-degree angle. Maintain normal posture.

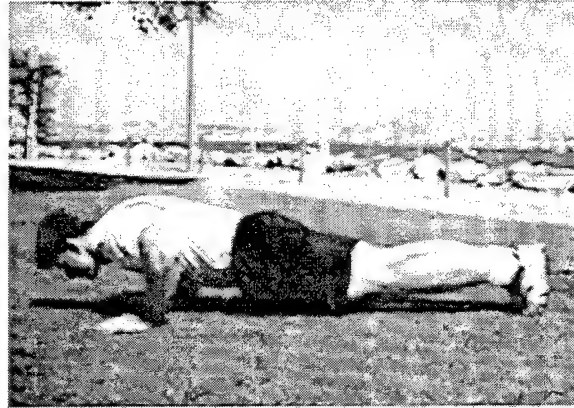
## MUSCLE STRENGTH AND CONDITIONING EXERCISES - GROUP A



**FIGURE 4. Push-Ups**

**STARTING POSTION:** Place hands on deck approximately shoulder-width apart and extend legs. Keep head and neck in neutral position.

**ACTION:** Lower body by bending arms until elbows reach 90-degree angle. Return to starting position.



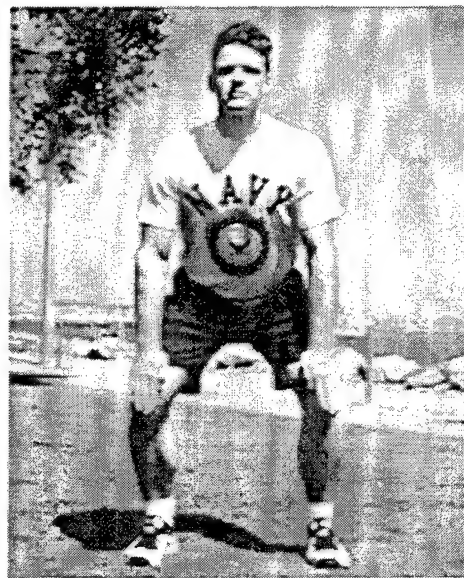
**FIGURE 4B. Push-Ups Cont.**



**FIGURE 5. Squats**

**STARTING POSTION:** Stand erect with head up, back flat, and feet shoulder-width apart. Place hands on front of thighs.

**ACTION:** Lower body by bending knees until hands touch knees. Hold squat position for 8 to 10 seconds. Return to starting position.



**FIGURE 5. Squats Cont.**



**FIGURE 6. Toe Raises**

**STARTING POSITION:** Stand erect with feet placed approximately 8 inches apart. Place hands on waist or at sides.

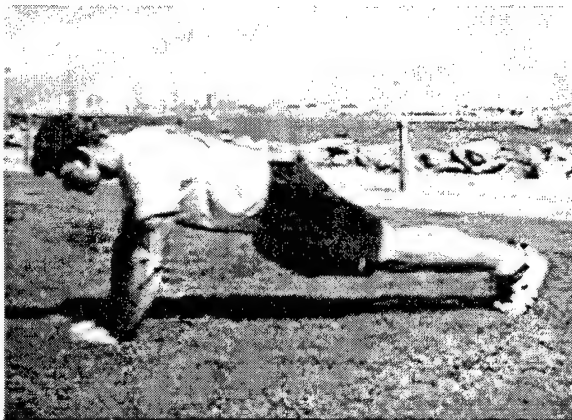
**ACTION:** Alternately raise toes of one foot off floor, holding each contraction for 8 to 10 seconds. Return to starting position.



**FIGURE 7. Heel Raises**

**STARTING POSITION:** Stand erect with feet placed approximately 8 inches apart. Place hands on waist.

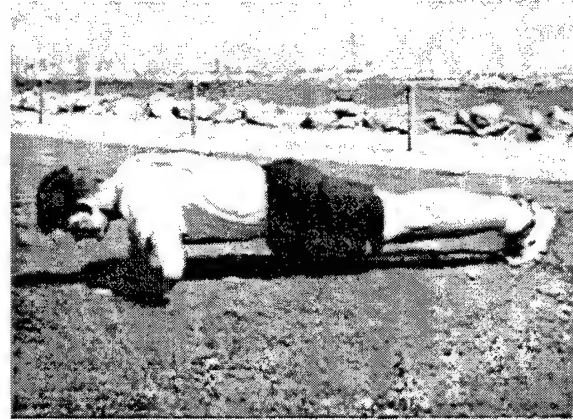
**ACTION:** Raise up on toes, lifting heels off deck. Hold raised-heel position for 8 to 10 seconds. Return to starting position.



**FIGURE 8. Narrow Grip Push-Ups**

**STARTING POSITION:** Place both hands on deck, forming a diamond with forefingers and thumbs. Extend legs, keeping head and neck in neutral position.

**ACTION:** Lower body by bending arms until elbows reach a 90-degree angle. Return to starting position.



**FIGURE 8. Narrow Grip Push-Ups Cont.**



**FIGURE 9. Front Lying Chest Lifts**

*STARTING POSTION:* Lie flat on deck, face down, legs extended. Bend elbows and place forearms and palms flat on deck at sides.

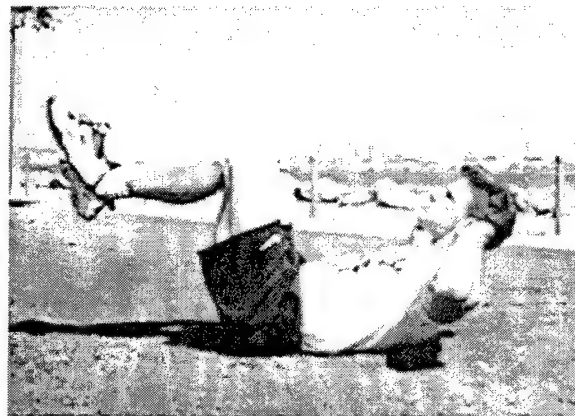
*ACTION:* Raise head and chest, tensing buttock and lower back muscles. Slowly return to starting position.



**FIGURE 10A. Trunk Curls**

*STARTING POSTION:* Lie on back with knees bent at 90-degree angle and hands placed behind head. Keep head and neck in neutral position.

*ACTION:* Raise head and neck until shoulder blades come off deck. Slowly return to starting position.



**FIGURE 10B. Trunk Curls Cont.**

## MUSCLE STRENGTH AND CONDITIONING EXERCISES - GROUP B



**FIGURE 11. Lunges**

*STARTING POSTION:* Stand erect with feet together.

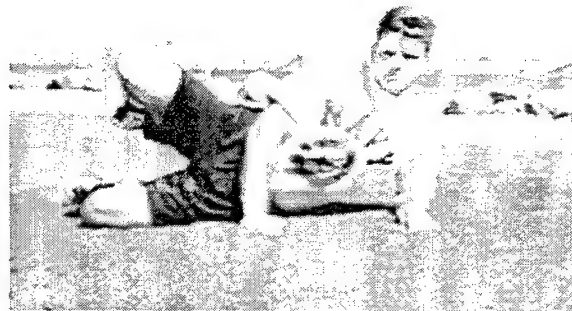
*ACTION:* Take a long step forward with one foot and bend back knee. Forward knee should not pass over forward foot. Return to starting position. Repeat on opposite side.



**FIGURE 12A. Outer Thigh Lifts**

*STARTING POSTION:* Lie on side with knees bent and thighs parallel.

*ACTION:* Lift top leg as high as possible and return to starting position. Repeat on opposite side.



**FIGURE 12B. Outer Thigh Lifts Cont.**

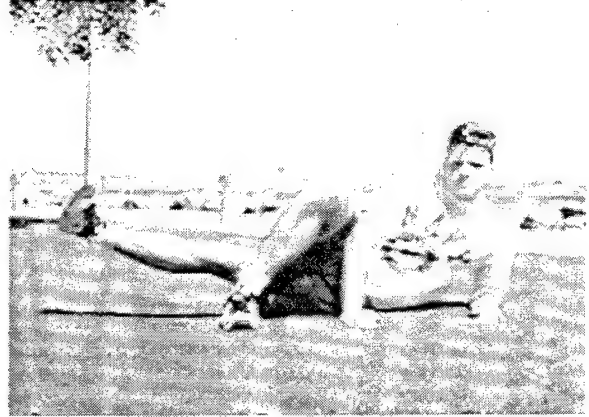




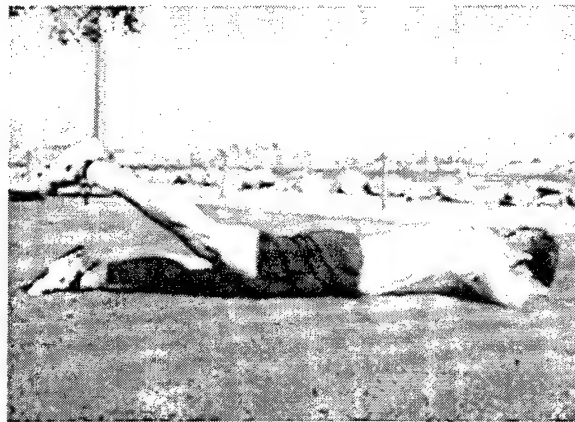
**FIGURE 13A. Inner Thigh Lifts**

**STARTING POSTION:** Lie on side with top leg bent over bottom leg.

**ACTION:** Lift bottom leg as high as possible. Return to starting position. Do not lean backward; stay on side. Repeat with opposite leg.



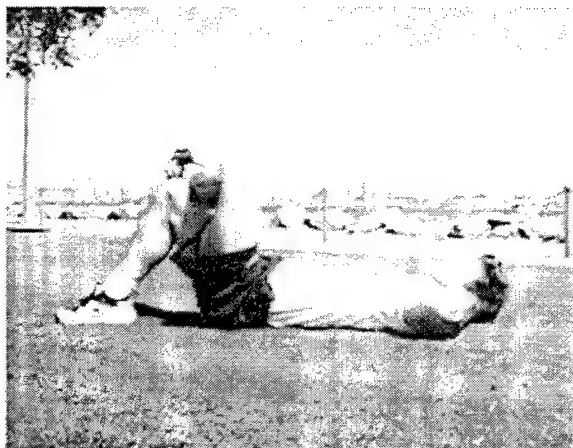
**FIGURE 13B. Inner Thigh Lifts Cont.**



**FIGURE 14. Front Lying Leg Lifts**

**STARTING POSTION:** Lie face down with head on hands.

**ACTION:** Lift one leg as high as possible. Return to starting position. Repeat with opposite leg.



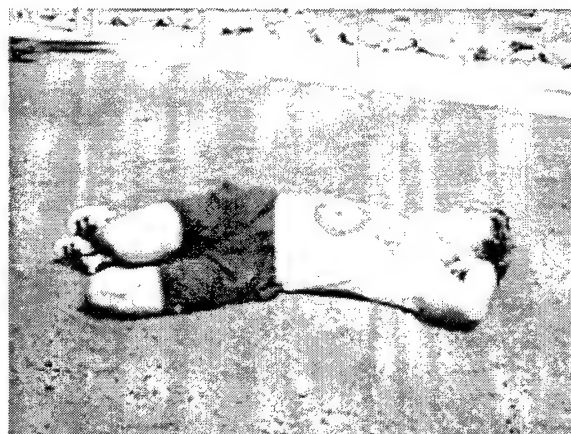
**FIGURE 15A. Twisting Trunk Curls**

**STARTING POSTION:** Lie on back with one knee bent at 90-degree angle and opposite foot resting on bent knee.

**ACTION:** Slowly curl upper back off deck, bringing opposite elbow and knee together on alternate repetitions.



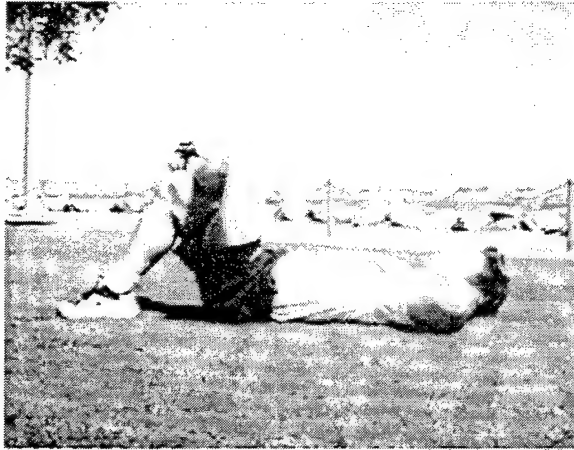
**FIGURE 15B. Twisting Trunk Curls Cont.**



**FIGURE 16. Hip Rollers**

**STARTING POSTION:** Lie on back with knees bent at 90-degree angle and shoulders on deck. Place arms straight out to sides or hands behind head.

**ACTION:** Rotate knees to one side, keeping shoulders on ground. Return to starting position, then rotate knees to opposite side.



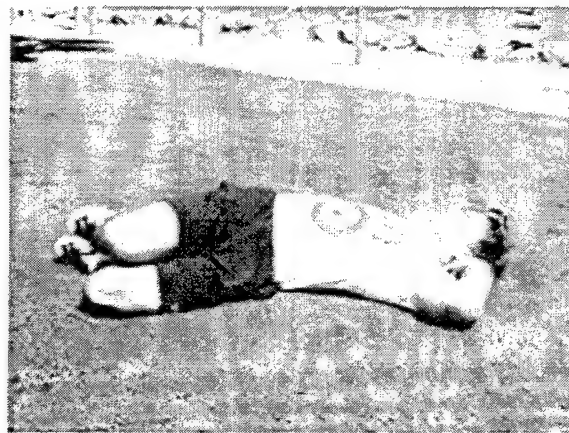
**FIGURE 15A. Twisting Trunk Curls**

**STARTING POSTION:** Lie on back with one knee bent at 90-degree angle and opposite foot resting on bent knee.

**ACTION:** Slowly curl upper back off deck, bringing opposite elbow and knee together on alternate repetitions.



**FIGURE 15B. Twisting Trunk Curls Cont.**



**FIGURE 16. Hip Rollers**

**STARTING POSTION:** Lie on back with knees bent at 90-degree angle and shoulders on deck. Place arms straight out to sides or hands behind head.

**ACTION:** Rotate knees to one side, keeping shoulders on ground. Return to starting position, then rotate knees to opposite side.

## COOL-DOWN / FLEXIBILITY



**FIGURE 17. Neck Stretch**

**STARTING POSITION:** Stand erect with arms placed at sides.

**ACTION:** Slowly lean head sideways toward shoulder and hold. Return to starting position. Repeat on opposite side.



**FIGURE 18. Rounded Shoulder Reach**

**STARTING POSITION:** Stand erect with fingers interlaced and palms turned outward.

**ACTION:** Extend arms outward and upward to shoulder level. Keep neck and shoulders in relaxed position.



**FIGURE 19. Chest, Shoulder, and Biceps Stretch**

**STARTING POSITION:** Stand erect with fingers interlaced behind back.

**ACTION:** Slowly straighten and lift arms, turning elbows inward.



**FIGURE 20. Back Scratch Stretch**

*STARTING POSTION:* Stand erect. Place arms overhead. Hold elbow of one arm with hand of the other arm.

*ACTION:* Gently pull elbow behind head and hold.



**FIGURE 21. Overhead Side Bends**

*STARTING POSTION:* Stand erect with arms extended overhead. Grasp right wrist with left hand. Cross left leg over right leg.

*ACTION:* Bend slowly to left side, using left arm to gently pull right arm over head and down to ground. Return to starting position. Repeat on opposite side.



**FIGURE 22. Spinal Twist**

*STARTING POSTION:* Sit with left leg bent inward. Bend right leg, cross right foot over, and rest it to outside of left thigh or left shin.

*ACTION:* Use left elbow to apply pressure to right knee. Turn head and torso to right. Return to starting position. Repeat on opposite side.



**FIGURE 23. Seated Butterfly Stretch**

**STARTING POSITION:** Sit erect with soles of feet together. Grasp ankles.

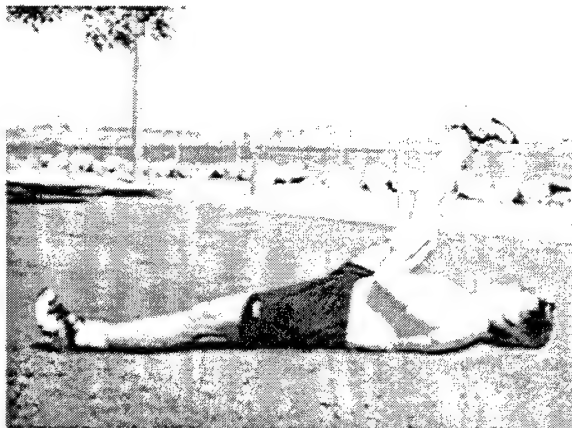
**ACTION:** Use elbows to apply pressure to inside of thighs. Keep back straight, and hold stretch. Return to starting position.



**FIGURE 24. Standing Hip Flexor Stretch**

**STARTING POSITION:** Take long step forward with one leg. Bend back knee slightly. Place hands on waist.

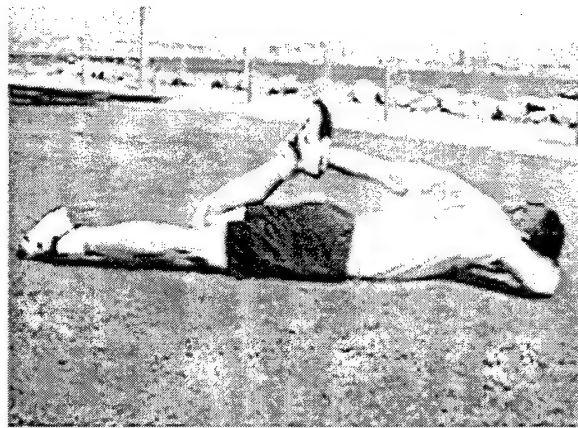
**ACTION:** Slowly tilt pelvis under, contracting buttock muscles. Return to starting position. Repeat on opposite side.



**FIGURE 25. Supine Hamstring Stretch**

**STARTING POSITION:** Lie on back. Extend one leg up, and grasp thigh.

**ACTION:** Gently pull thigh toward chest and hold. Return to starting position. Repeat on opposite side.



**FIGURE 26. Prone Quadriceps Stretch**

**STARTING POSITION:** Lie face down, resting head on one hand. Take opposite hand and grasp ankle of same side, bending knee.

**ACTION:** Gently pull ankle straight back toward buttocks and hold. Return to starting position. Repeat on opposite side.



**FIGURES 27A . & 27B. Straight and Bent-Knee Standing Calf Stretch**

*STARTING POSTION:* Take long step forward.  
Forward knee should not pass over forward foot.  
Place hands on waist or at sides.

*ACTION:* Straighten back knee, keeping back heel on ground, and hold. Keeping same position, bend back knee and hold. Return to starting position. Repeat on opposite side.

## Appendix B

### Recommended 8-Week Physical Training Schedule for NTC Recruits



# **Recommended Physical Training Schedule For NTC Recruits**

## Alpha Schedule

Day/ Week	1/MON	2/TUES	3/WED	4/THUR	5/FRI	6/SAT	7/SUN
P							LITE
1		Aerobic		Strength & Conditioning	Aerobic		Strength & Conditioning
2		Confidence Course [2 hr]	Aerobic		Strength & Conditioning		Aerobic
3	LITE	Strength & Conditioning	Aerobic		Strength & Conditioning		Aerobic
4		Strength & Conditioning	LITE	PRT #1 [2 hr]		Strength & Conditioning	
5	S E R V I C E   W E E K						Strength & Conditioning
6		Aerobic		Strength & Conditioning	Confidence Course [2 hr]	DC Olympics [5 hr]	Aerobic
7		Strength & Conditioning	LITE	Final PRT [2 hr]	Strength & Conditioning	Seamanship Olympics [5 hr]	
8	Aerobic	Strength & Conditioning	LITE	Graduation			

Total = 52 hr 20 min    [Low Intensity Training and Exercise (LITE) = 1 hr; Aerobic, Strength & Conditioning Sessions = 1 hr 20 min]

## Recommended Physical Training Schedule

### Bravo Schedule

Day/ Week	1/MON	2/TUES	3/WED	4/THUR	5/FRI	6/SAT	7/SUN
P							LITE
1		Aerobic		Strength & Conditioning	Aerobic		Strength & Conditioning
2		Confidence Course [2 hr]	Aerobic		Strength & Conditioning		Aerobic
3	LITE	Strength & Conditioning	Aerobic		Strength & Conditioning		Aerobic
4		Strength & Conditioning	LITE	PRT #1 [2 hr]	Strength & Conditioning		
5	SERVICE WEEK						Strength & Conditioning
6		Aerobic		Strength & Conditioning	Confidence Course [2 hr]	DC Olympics [5 hr]	Aerobic
7	Strength & Conditioning		LITE	Final PRT [2 hr]	Strength & Conditioning	Seamanship Olympics [5 hr]	
8	Aerobic	Strength & Conditioning	LITE	Graduation			

Total = 52 hr 20 min [Low Intensity Training and Exercise (LITE) = 1 hr; Aerobic, Strength & Conditioning Sessions = 1 hr 20 min]

# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

**1. AGENCY USE ONLY (Leave blank)**

**2. REPORT DATE**  
10 March 97

**3. REPORT TYPE & DATE COVERED**  
Final  
01 OCT 95 - 30 SEP 96

**4. TITLE AND SUBTITLE** Guidelines for Developing a Physical Training Program for U.S. Navy Recruits

**5. FUNDING NUMBERS**  
Work Unit Number:  
CNET Reimbursable-6617

**6. AUTHOR(S)** S.A. Almeida, K. Maxwell Williams, R. Y. Minagawa, D. M. Benas, R.A. Shaffer

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**  
Naval Health Research Center  
P.O. Box 85122  
San Diego, CA 92186-5122

**8. PERFORMING ORGANIZATION**  
Tech Document 96-11K

**9. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)**  
Naval Medical Research and Development Command  
National Naval Medical Center  
8901 Wisconsin Ave  
Bethesda, MD 20889-5606

**10. SPONSORING/MONITORING  
AGENCY REPORT NUMBER**

**11. SUPPLEMENTARY NOTES**

**12a. DISTRIBUTION/AVAILABILITY STATEMENT**  
Approved for public release; distribution is unlimited.

**12b. DISTRIBUTION CODE**  
A

**13. ABSTRACT (Maximum 200 words)** Musculoskeletal injuries result in patient morbidity, increased training costs, and reduced operational readiness in military training populations. Recruits at Naval Training Center (NTC), Great Lakes, are at risk for exercise-related musculoskeletal injuries due to the sudden increases in vigorous physical activity associated with boot camp training. The objective of this research was to evaluate the physical training schedule at NTC, Great Lakes, and to develop a recruit physical conditioning program that would minimize musculoskeletal injuries and promote long-term fitness practices. Study Phases 1 and 2 included data collection to determine NTC recruit injury rates, pretraining and posttraining fitness levels, and patterns of training-related physical activity. A physical conditioning program was then developed targeting the training needs identified during study Phases 1 and 2. The program included exercises for cardiovascular endurance, muscle conditioning, and flexibility. All exercise techniques were modifiable for land-based shipboard environments and required no special equipment. We concluded that a needs-specific physical conditioning program based on scientific principles and epidemiologic data can be developed to maximize fitness gains and minimize exercise-related injuries in NTC recruits. This fitness program can be taught during boot camp to promote long-term fitness practices in U.S. Navy personnel.

**14. SUBJECT TERMS**  
conditioning, exercise, injuries, Navy recruits, physical training

**15. NUMBER OF PAGES**  
41

**16. PRICE CODE**

**17. SECURITY CLASSIFICATION OF REPORT**  
Unclassified

**18. SECURITY CLASSIFICATION OF THIS PAGE**  
Unclassified

**19. SECURITY CLASSIFICATION OF ABSTRACT**  
Unclassified

**20. LIMITATION OF ABSTRACT**  
Unlimited